Attorney's Docket No. 9362-4

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Williams et al.
Serial No.: 10/662,621
Filed: September 15, 2003
Group Art Unit: 1615
Confirmation No.: 9764
Examiner: Neil S. Levy
For: *CARBON DIOXIDE-ASSISTED METHODS OF PROVIDING BIOCOMPATIBLE INTRALUMINAL PROSTHESES*

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Declaration Under 37 C.F.R § 1.132 of Joseph M. DeSimone, Ph.D.

I, Joseph M. DeSimone, Ph.D., do hereby declare and say as follows:

1. I am the William R. Kenan Jr. Distinguished Professor of Chemistry and Chemical Engineering at the University of North Carolina at Chapel Hill and North Carolina State University. I obtained my Ph.D. in Chemistry from Virginia Polytechnic Institute and State University and my Bachelors of Science in Chemistry from Ursinus College. My *curriculum vitae* is provided with this declaration.

2. My research interests are in the areas of polymer synthesis and in using compressed carbon dioxide in industrial processes. I am an inventor on over 100 patents related to polymer synthesis and/or carbon dioxide processes.

3. I am a named inventor on U.S. Patent Application Serial No. 10/662,621 ("the present application").

4. I have read and understood the Bawa et al. publication (U.S. Patent No. 6,071,439) cited by the Examiner in connection with the present application.

5. Bawa et al. concerns the treatment of contact lenses with supercritcal fluids. However, the polymers focused on and tested in Bawa et al. are elastomeric hydrogels, which have significantly different physical properties than the following thermoplastic polymers: surgical gut, silk, cotton, liposomes, poly(lactic acid), poly(L-lactic acid), poly(D,L-lactic acid), poly(glycolic acid), poly(D-lactic-co-glycolic acid), poly(L-lactic-co-glycolic acid), poly (D,L-lactic-co-glycolic acid), poly(Є-caprolactone), poly(valerolactone), poly(hydroxy butyrate), poly(hydrovalerate), polydioxanone, poly(propylene fumarate), and copolymers thereof, and collagen and chitosan.

6. Bawa et al. generally describes using its processes with polysiloxane hydrogels, which are crosslinked or thermoset elastomers. A crosslinked elastomer is "rubbery" and cannot be melted (only degraded by breaking covalent chemical bonds) because the polymer chains are "locked" in a three dimensional network due to the crosslinks.

7. Plasticization is the physical process by which a polymer becomes softer, or more flexible, as a result of adding to the polymer a compound that has strong interactions with the polymer. This can cause the polymer to soften, and if the polymer is not crosslinked, to flow. Carbon dioxide is a plasticizer for many polymers.

8. When treated with carbon dioxide, crosslinked elastomers may become slightly plasticized but can return to the original form once carbon dioxide pressure is removed because the rubbery polymer chains are locked into the three dimensional structure and so can return to the original form. Therefore, if a crosslinked elastomer, such as a polysiloxane hydrogel, is treated with carbon dioxide, one would not expect it deform appreciably from its original structure.

9. In contrast, the thermoplastic materials that are being now being claimed in the present application can flow and therefore are deformable, such that they can be melted into a liquid (*e.g.*, via the application of heat or by application of pressurized carbon dioxide) and then frozen to a glassy state (*e.g.*, via cooling or removal of carbon dioxide pressure). When a thermoplastic material is deformed via plasticization or melting, the material generally does not return to its former shape upon removal of the carbon dioxide, but instead will remain in its deformed shape. Therefore, a polymer chemist or engineer would not have expected that the methods of Bawa et al., which relate to the treatment of crosslinked elastomers, could be used on a stent formed from thermoplastic materials without deforming the stent.

10. Bawa et al. does make a passing reference to the use of its methods for so-called "hard" contact lenses made of polymers such as poly(methyl methacrylate) (PMMA), which is also thermoplastic. However, thermoplastic materials like PMMA are very different from the elastomeric hydrogels that are the focus of Bawa et al., and so a polymer chemist/engineer would not have expected that Bawa et al.'s techniques could necessarily be used without deforming thermoplastic materials. Therefore, a polymer chemist/engineer would not have thought that a stent formed from a thermoplastic polymer could be treated by Bawa et al.'s methods without deforming the stent, and thus deteriorating its usefulness.

11. I have read and understood the Hile et al. reference (*Journal of Controlled Release*, 66, 2000, 177-185) cited by the Examiner in connection with the '621 application.

12. Hile et al. concerns techniques for preparing polymer foams containing encapsulated proteins using supercritical carbon dioxide. Although Hile et al. describes "extraction" of solvents from polymers, the processes described in Hile et al. are fundamentally different from those described in the '621 application.

13. In Hile et al., a water-in-solvent emulsion is first prepared, such that a protein is present in the aqueous phase and a polymer is dissolved in the organic phase. The emulsion is then pipetted into a mold, which is then placed in a high pressure cell. The cell is then pressurized with carbon dioxide until supercritical conditions, above 31 °C and 1070 psi (as a point of reference, car tires generally have a pressure of less than 40 psi), are obtained. The extraction in Hile et al. occurs when the solvent that was associated with the polymer dissolves in the carbon dioxide and the carbon dioxide then associates with the polymer. At some point, the cell is rapidly depressurized, which causes the polymer to foam and the carbon dioxide, and some of the solvent dissolved in it, to be evacuated from the cell. Therefore, some of the solvent is separated from the polymer after depressurization, which is what Hile et al. refers to as extraction of the solvent.

14. In contrast, in the present application, a fully formed stent is immersed in carbon dioxide. The solvent is extracted from a solid polymer form (stent), not a dissolved polymer.

15. Thus, the processes of Hile et al. are very different from the processes described in the present application because, in the present application, the stent is already formed. Therefore, the structure does not result from the carbon dioxide processing as in Hile et al., but instead, the structure is formed prior to contact with the condensed carbon dioxide. Indeed, one of the surprising features of the invention is that the carbon dioxide does not significantly affect the structure of the stent, and so solvent can be extracted from the fully formed stent without deforming the stent. It is also important to note that in the present application, the solvents or other contaminants are being extracted from solid polymeric material, not from dissolved polymeric material as in Hile et al., and so one would not expect that just because a solvent was partially extracted from a plasticized polymer in Hile et al., that it could be extracted from a solidified, formed polymer stent.

16. I do hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Joseph M. DeSimone, Ph.D.

Jan 22, 2007
Date